

Pan-  
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# First Pan Pacific Scientific Conference

Under the Auspices of the

## PAN PACIFIC UNION

HONOLULU, HAWAII

August 2 to 20, 1920

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### PART I

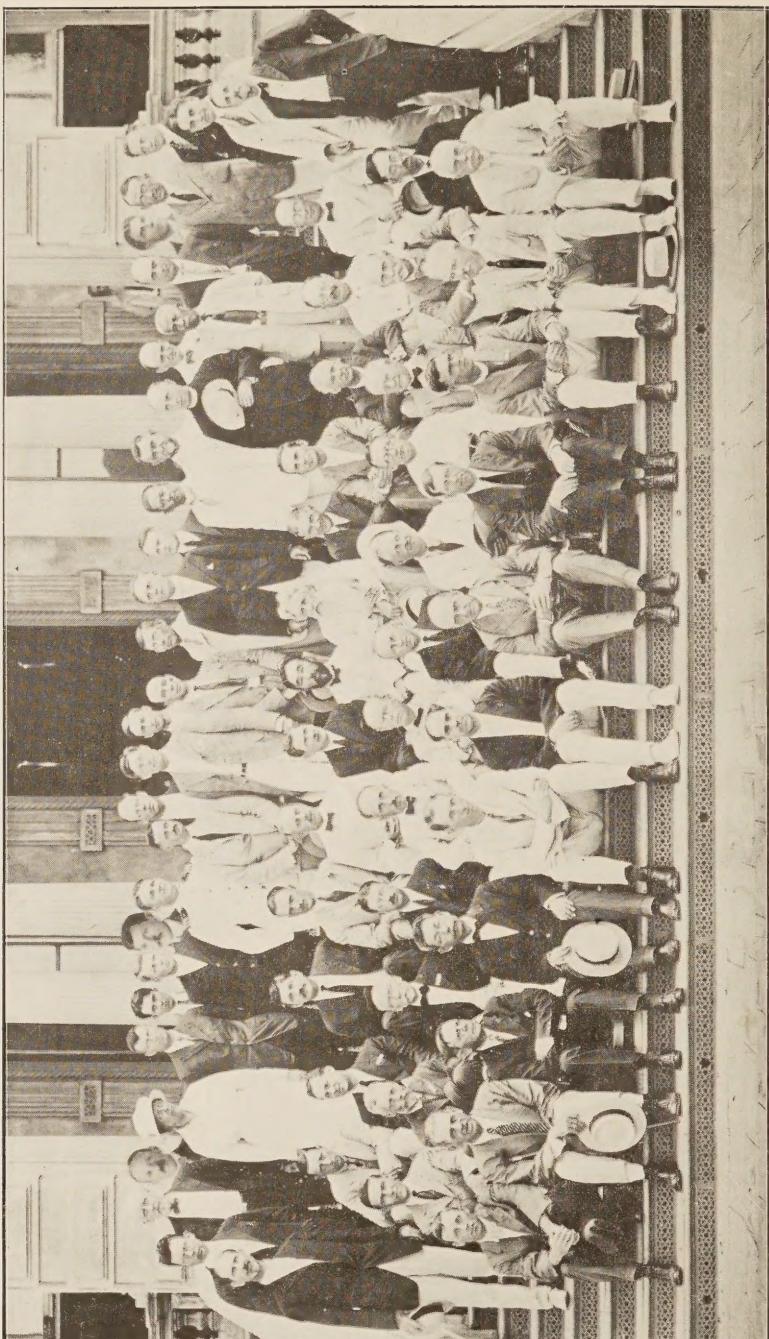
ORGANIZATION  
PROCEEDINGS  
RESOLUTIONS

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HONOLULU, NOVEMBER, 1920







DELEGATES TO PAN-PACIFIC SCIENTIFIC CONGRESS

# First Pan Pacific Scientific Conference

Under the Auspices of the

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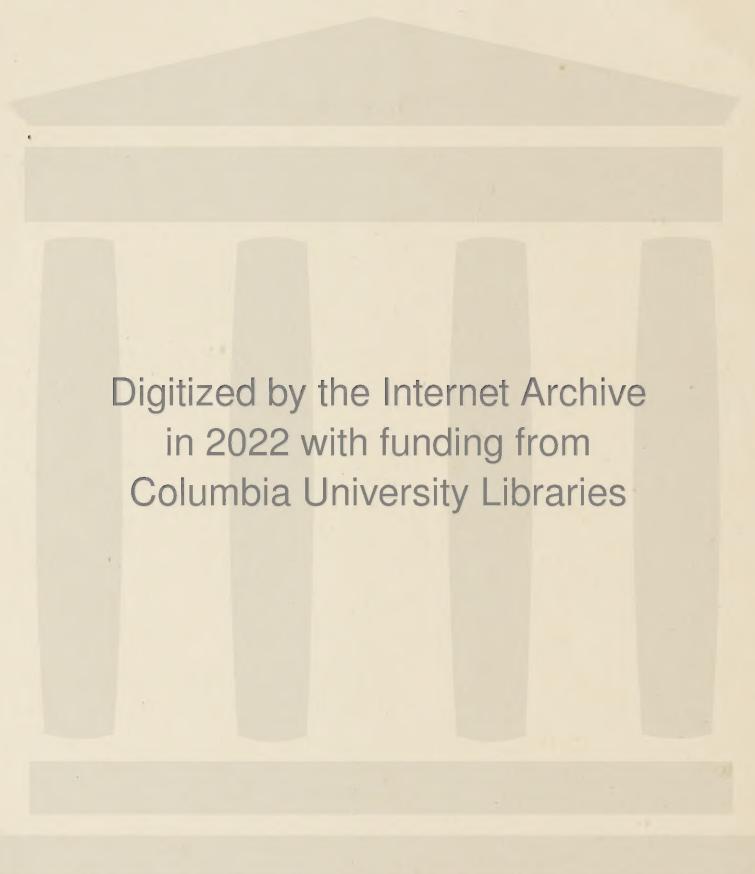
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HONOLULU, NOVEMBER, 1920

The Scientific Conference was the first of a series of conferences to be held in Honolulu under the auspices of the Pan-Pacific Union. The purpose of the Conference was to outline the scientific problems of the Pacific Ocean region and suggest methods for their solution. The Conference undertook to take stock of our present knowledge of the Pacific area, its geography and geology, its plants and animals and the races of men which inhabit it, and proceeding from this comprehensive view to formulate the programs for future research.

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## ORGANIZATION

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Chairman.....HERBERT E. GREGORY  
Vice-Chairman and Secretary.....ARTHUR L. DEAN

### EXECUTIVE AND PROGRAM COMMITTEE

The Chairman, the Vice-Chairman and the Leaders of the Sections.

### COMMITTEE ON PUBLICATIONS.

Herbert E. Gregory, Chairman. A. L. Dean, T. Wayland Vaughan, Henry S. Washington.

### COMMITTEE OF THE PAN-PACIFIC UNION.

George P. Denison, Chairman. F. C. Atherton, C. K. Ai, W. R. Castle, W. F. Frear, A. Lewis, Jr., Prince Kuhio Kalanianaole, Vaughan MacCaughey, I. Mori, R. H. Trent; Ex-officio: the President, Secretary and Treasurer of the Pan-Pacific Union.

### COMMITTEE ON ARRANGEMENTS.

John R. Galt, Chairman. Robbins B. Anderson, Lyman H. Bigelow, C. H. Edmondson, Alonzo Gartley, T. A. Jaggar, Jr., Lorrin A. Thurston, Gerrit P. Wilder. Secretary, Miss A. Y. Satterthwaite.

### ORGANIZATION OF SECTIONS.

#### ANTHROPOLOGY

Leader, Clark Wissler, Curator of Anthropology, American Museum of Natural History, New York City.  
Secretary, John F. G. Stokes, Anthropologist, Bernice P. Bishop Museum, Honolulu.

#### BIOLOGY

Leader, Charles Chilton, Professor of Biology, Canterbury College, Christchurch, New Zealand.  
Secretary, C. H. Edmondson, Professor of Zoology, University of Hawaii.

#### BOTANY

Leader, W. E. Safford, Economic Botanist, United States Department of Agriculture.

Secretary, Charles N. Forbes, Curator of Botany, Bishop Museum; Mrs. Forest B. H. Brown, Research Associate in Botany, Bernice P. Bishop Museum, Honolulu.

#### ENTOMOLOGY

Leader, F. Muir, Entomologist, Hawaiian Sugar Planters' Association.

Secretary, D. T. Fullaway, Entomologist, Board of Agriculture and Forestry, Territory of Hawaii.

#### GEOGRAPHY

Leader, William Bowie, Chief Division of Geodesy, United States Coast and Geodetic Survey.

Secretary, G. W. Littlehales, Geographer, U. S. Bureau of Navigation.

Sub-Sections: Geodesy and Topography, N. Yamasaki, Chairman; Terrestrial Magnetism, J. T. Watkins, Chairman; Meteorology, L. H. Daingerfield, Chairman; Physical Oceanography, G. F. McEwen, Chairman.

#### GEOLOGY

Leader, T. Wayland Vaughan, United States Geological Survey.

Secretary, Harold S. Palmer, Assistant Professor of Geology, University of Hawaii.

#### SEISMOLOGY AND VOLCANOLOGY

Leader, Fusakichi Omori, Director, Seismological Institute, Tokyo, Japan.

Secretary, T. A. Jaggar, Jr., Director, Hawaiian Volcano Research Observatory.

## PROCEEDINGS OF THE GENERAL SESSIONS

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MONDAY, AUGUST 2, 9:00 a. m.

Chairman: Herbert E. Gregory.

### ADDRESSES OF WELCOME.

Hon. C. J. McCarthy, Governor of Hawaii.

Hon. George R. Carter, ex-Governor of Hawaii.

A. L. Dean, President, University of Hawaii.

H. P. Agee, Director, Experiment Station of the Hawaiian Sugar Planters' Association.

A. F. Judd, President, Board of Trustees, Bernice Pauahi Bishop Museum.

### ADDRESSES ON SALIENT FEATURES OF SCIENCE IN HAWAII.

William T. Brigham: Anthropology.

Charles N. Forbes: Botany.

Otto H. Swezey: Entomology.

H. A. Pilsbry: Conchology.

### READ BY TITLE.

Charles H. Edmondson: Marine Biology.

Lawrence H. Daingerfield: Meteorology.

T. A. Jaggar: Volcanology.

MONDAY, AUGUST 2, 2:00 p. m.

Chairman: Herbert E. Gregory.

### ORGANIZATION OF THE CONFERENCE.

Following preliminary statements regarding the plans for entertainment and the trip to Hawaii, the Chairman opened the subject of the organization of the Conference. It was

Voted: That the Chairman, Vice-Chairman, and the Leaders of the Sections constitute an executive and program committee.

## TUESDAY, AUGUST 3, 9:00 a. m.

Chairman: C. M. Fraser.

Subject: Ocean Currents and Their Significance.

George F. McEwen: The Pacific Ocean and Its Importance to Pacific Countries.

G. W. Littlehales: The Hydrographic Aspects of Ocean Currents.

N. Yamasaki: Oceanographic Research in Japan.

Lawrence H. Daingerfield: Meteorological Aspects of Ocean Currents.

R. A. Daly, of Harvard University: Some Suggestions for Geological Research in the Pacific Islands. (Read by the Secretary.)

R. C. Wells: Chemistry of Natural Waters.

H. S. Washington: Relations of Geological Change to Ocean Currents.

Wm. Bowie: Influence of Isostasy on Ocean Currents.

J. T. Watkins: Inshore Currents.

## WEDNESDAY, AUGUST 4.

No general sessions. The delegates made the trip around the island of Oahu with informal addresses at points of interest.

## THURSDAY, AUGUST 5, 9:00 a. m.

Chairman: Joseph A. Cushman.

Subject: Hawaiian Flora and Fauna.

Forest B. H. Brown: The Origin of Hawaiian Flora.

F. Muir: The Origin of the Hawaiian Flora and Fauna.

H. A. Pilsbry: The Dispersal and Affinities of Polynesian Land Snail Faunas.

W. A. Bryan: Origin of Hawaiian Flora and Fauna.

Discussion by: Alfred G. Mayor, William E. Safford, Paul Bartsch, H. A. Pilsbry.

## FRIDAY, AUGUST 6, 9:00 a. m.

Chairman: F. Wood-Jones.

Subject: Race Relations in the Pacific.

H. E. Gregory: The Dominick Expedition.

A. G. Mayor: Similarity Between Japanese and Polynesians.

A. F. Judd: Scarcity of Proper Wall Maps and Teachers Familiar With Geography of Pacific Lands.

Clark Wissler: Man in the Pacific.

A. L. Kroeber: Anthropology of the Philippines.

L. R. Sullivan: Physical Anthropology in Polynesia.

Alfred Tozzer: Anthropological Study of the Hawaiian Race.

J. F. G. Stokes: Religious Significance of Polynesian Feather Work.

T. G. Thrum: Hawaiian Archaeology—Temple Structure.

Discussion by: W. E. Safford, Chas. Hedley, A. G. Mayor, Forest Brown.

### SATURDAY, AUGUST 7, 9:00 a. m.

Chairman: Leo A. Cotton.

Subject: Relation of Ocean Currents to Marine Organisms.

Paul Bartsch: Ocean Currents, the Prime Factor in the Distribution of Marine Mollusks on the West Coast of America.

H. F. Moore: Relation of Ocean Currents to Fish.

T. C. Frye: Ocean Currents and the Problem of More Food for Man.

Wm. E. Safford: Dispersal of Plants by Ocean Currents.

Discussion by: H. A. Pilsbry, G. F. McEwen, T. Wayland Vaughan, Charles Hedley, G. W. Littlehales, A. G. Mayor, Charles Chilton, C. M. Fraser.

### AUGUST 8 to AUGUST 13

The delegates visited the Island of Hawaii, devoting special attention to the crater of Kilauea.

### SATURDAY, AUGUST 14, 9:00 a. m.

Chairman: T. Wayland Vaughan.

Subject: The Framework of the Pacific.

E. C. Andrews: The Structural Unity of the Suboceanic Mass of the Pacific Ocean.

R. T. Chamberlin: Framework of the Pacific and Its Relation to the Americas.

F. Omori: Geographic Distribution of Volcanoes in the Pacific.

Wm. Bowie: The Bearing of Geodetic Investigation on the Knowledge of the Geologic Structure of the Pacific.

Discussion by: H. S. Washington, C. A. Sussmilch, T. A. Jaggar, W. D. Smith, L. A. Cotton, Wm. Bowie, R. C. Wells,

MONDAY, AUGUST 16, 9:00 a. m.

Chairman: J. Allan Thomson.

Subject: Mapping of the Pacific.

William Bowie: Shore Lines of the Pacific.

G. R. Davis: Coast and Island Topography.

T. Wayland Vaughan: Sedimentation and Bottom Configuration.

George F. McEwen: Recommendations Concerning Investigations of the Pacific Ocean Waters.

G. W. Littlehales: The Deeps of the Pacific Ocean.

N. Yamasaki: Islands of the South Pacific.

J. T. Watkins: The Survey of the Shoreline and Coastal Waters of the Pacific Ocean.

E. A. Beals: The Importance for Weather Forecasting of a Thorough Knowledge of the Pacific.

Discussion by: H. F. Moore, Paul Bartsch, H. C. Richards, L. A. Cotton, C. M. Fraser, J. Allan Thomson, A. G. Mayor, T. Wayland Vaughan, R. C. Wells.

TUESDAY, AUGUST 17, 9:00 a. m.

Chairman: Elmer D. Merrill.

Subject: Presentation by Sections of Programs of Research.

The Leaders reported the resolutions recommended by their Sections.

Clark Wissler: For the Section of Anthropology.

C. M. Fraser: For the Section of Biology.

Wm. E. Safford: For the Section of Botany.

Wm. Bowie: For the Section of Geography.

T. Wayland Vaughan: For the Section of Geology.

T. A. Jaggar, Jr.: For the Section of Seismology and Volcanology.

Following the discussion of the resolutions it was

Voted: To print the proposed resolutions and distribute copies among the delegates for their study.

Voted: To refer the proposed resolutions to the Publication Committee for revision with instructions to report back to the general session of the Conference to be held August 20.

WEDNESDAY, AUGUST 18, 9:00 a. m.

Chairman: N. Yamasaki.

Subject: Training of Scientists for Pacific Work.

Addresses by: A. L. Dean, Wm. Bowie, H. C. Richards, W. E. Safford, A. F. Judd, E. C. Andrews, B. W. Evermann, Paul Bartsch, Chas. Chilton, H. E. Gregory, Josephine Tilden, L. A. Cotton, C. M. Fraser, T. W. Vaughan.

THURSDAY, AUGUST 19, 9:00 a. m.

Chairman: C. A. Sussmilch.

Subject: Means and Methods of Cooperation.

The following delegates addressed the conference in behalf of the several institutions represented by them.

H. C. Richards: The University of Queensland.

Barton W. Evermann: The California Academy of Sciences.

J. Allan Thomson: The Government of New Zealand, Institutions of New Zealand and Individual Scientists.

C. M. Fraser: The Biological Station, Nanaimo, B. C.

Charles Hedley: The Australian Museum, Sydney.

John B. Henderson: The United States National Museum.

K. Kishinouye: Japan.

George F. McEwen: The Scripps Institution for Biological Research, of the University of California.

William E. Ritter: (Read by G. F. McEwen)—The Role of the Scripps Institution in a Program of Pacific Exploration.

A. F. Judd: The Bernice P. Bishop Museum.

H. A. Pilsbry: The Philadelphia Academy of Sciences.

Elmer D. Merrill: The Philippine Bureau of Science.

E. O. Hovey: The American Museum of Natural History.

William E. Safford: The United States Department of Agriculture.

Charles Chilton: Canterbury College, Christchurch, N. Z.

H. F. Moore: The United States Bureau of Fisheries.

T. C. Frye: The Puget Sound Biological Station of the University of Washington.

Josephine Tilden: Inland Universities.

FRIDAY, AUGUST 20, 9:00 a. m.

Chairman: A. L. Dean.

Subject: Adoption of Resolutions.

Resolutions were presented by:

F. Wood-Jones on Anthropology,

Charles Chilton on Biology,

W. E. Safford on Botany,

William Bowie on Geography,

T. Wayland Vaughan on Geology,

T. A. Jaggar, Jr., on Seismology and Volcanology.

General Resolutions were presented by:

H. E. Gregory on Ships for Exploration,

William Bowie on the International Research Council,

H. E. Gregory on Future Conferences,

H. E. Gregory on Permanent Organization,

A. L. Dean on Promotion of Education.

The resolutions as adopted are printed elsewhere.

H. S. Washington presented a resolution thanking the institutions and individuals in Hawaii whose cooperation and hospitality had contributed to the success of the Conference and the pleasure of the Delegates.

It was voted to request the Bishop Museum to preserve the records of the Conference, to publish and distribute the reports, papers and proceedings, and to act as representative of the members of the Conference after its adjournment.

It was voted that the Delegates from each country represented at the Conference elect one of their number to serve on a committee to arrange for future Conferences. The following were selected to serve with Herbert E. Gregory: E. C. Andrews, Australia; C. M. Fraser, Canada; F. Omori, Japan; Charles Chilton, New Zealand; T. Wayland Vaughan, United States.

## PROCEEDINGS OF THE SECTIONS.

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### SECTION OF ANTHROPOLOGY.

Monday, August 2.

The Section was organized with Clark Wissler, Leader, and J. F. G. Stokes Secretary. The work of the Section was outlined.

Tuesday, August 3.

On plans for an extended exploration of the Pacific, and on the characteristics of the Hawaiians in 1864-5. William T. Brigham.

Thursday, August 5.

Report of the Archaeological Committee, presented by J. F. G. Stokes.

Report of the Committee on Linguistics, presented by A. L. Kroeber.

Friday, August 6.

Hawaiian Temples. Thomas G. Thrum. Read by Gerard Fowke.

Anthropology of Formosa. N. Yamasaki.

Kitchen Middens of Japan. K. Kishinouye.

Anthropology in Australia. F. Wood-Jones.

Influence of Insects on Race Distribution. F. Muir

Monday, August 16.

Notes on the Migrations and Dispersals of the Polynesians. J. F. G. Stokes.

Alleged Similarity of Fortified Villages in New Zealand and Fiji. J. Allan Thomson.

Committee appointed to formulate a statement regarding the value of records of early Spanish and Whaling Voyages.

Tuesday, August 17.

Report of Committee on Spanish and Whaling Voyages, presented by F. Wood-Jones.

Letter from Charles B. Davenport on the "Type Unit" Method of investigation.

Letter from David Fairchild of the American Genetic Association on the subject of heredity.

Consideration of resolutions to be presented to the general sessions of the Conference.

Suggestions on botanical methods calculated to be of ethno-botanical value. Miss Josephine Tilden. Read by the Chairman.

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#### SECTION OF BIOLOGY.

Monday, August 2.

Section organized with Charles Chilton, Leader, and C. H. Edmondson, Secretary. The program of work for the Section was outlined.

Tuesday, August 3.

Discussion of the distribution of animals in the Pacific.

Joseph A. Cushman: Distribution of Foraminifera.

Paul Bartsch, John B. Henderson, and Henry A. Pilsbry: Distribution of Mollusca.

Charles Chilton: Distribution of Amphipods and Isopods.

F. Muir and O. H. Swezey: Distribution of Insects.

Charles H. Edmondson: Shallow Water Crustacea.

K. Kishinouye: Relationships of the Fauna of Japanese Waters.

C. M. Fraser: Distribution of Hydroids.

T. Wayland Vaughan: Distribution of Corals.

The general conclusion was that the weight of evidence supports a closer relationship with Indo-Pacific forms than with those of American shores.

Thursday, August 5.

Illustrated lecture, New Zealand's Call to the Botanist, by Charles Chilton.

Friday, August 6.

Joint meeting with Section of Geology. For program see report of Geology Section.

Saturday, August 14.

The Fisheries of Japan. K. Kishinouye.

Ocean Pastorage and Ocean Fisheries, a paper sent to the Conference by W. E. Allen of the Scripps Institution for Biological Research of the University of California.

The Necessity for Conservation of Fish Resources. Barton W. Evermann.

Further Data Showing the Necessity for Conservation of the Fish Supply. C. M. Fraser.

The Present Inadequacy of Statistics of Fisheries. H. F. Moore.

Monday, August 16.

Joint Meeting of the Sections of Botany and Zoology devoted to discussion of Biological Stations and other Scientific Institutions bordering the Pacific.

The Biological Station, Nanaimo, British Columbia. C. M. Fraser.

The Biological Station, Friday Harbor. T. C. Frye.

The Biological Station of Minnesota. Miss Josephine E. Tilden.

The Biological Station of California, and the Work of the Fish and Game Commission. Barton W. Evermann.

Biological Station in Australia. Chas. Hedley.

The Work of the National Museum. Paul Bartsch.

The Work of the Boston Society of Natural History. Joseph E. Cushman.

The work of the Natural History Society of Philadelphia. H. A. Pilsbry.

Biological Work in Japan. K. Kishinouye.

The Work of the Philippine Bureau of Science. Elmer D. Merrill.

The Work in Entomology in Honolulu. O. H. Swezey.

The Biological Station of the University of Hawaii. C. H. Edmondson.

The Bureau of Fisheries. H. F. Moore.

The Biological Station of New Zealand. Charles Chilton.

Consideration of resolutions to be presented to the general Conference.

Tuesday, August 18.

Experiments on the Growth of Reef Organisms. Frank Potts.

Discussion of the effect of temperature on the size of marine organisms, participated in by C. M. Fraser, H. F. Moore, C. H. Edmondson, B. W. Evermann, Paul Bartsch.

Breeding Experiments. Paul Bartsch.

Presentation of proposed program of research in Pacific Ocean Algae by Miss Josephine E. Tilden.

Wednesday, August 19.

Discussion of resolutions to be presented to the general Conference.

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#### SECTION OF BOTANY.

Monday, August 2.

Section organized with William E. Safford, Leader, and C. N. Forbes, Secretary. The work of the Section was outlined. Ethno-Botany of the Polynesians. William E. Safford.

Tuesday, August 3.

The American Element in Hawaiian Vegetation. Forest B. H. Brown.

Cultivated Plants of the Pacific Islands as an Index to the Migrations of the Polynesians. W. E. Safford.

Thursday, August 5.

Joint meeting of the Sections of Botany and Zoology.

New Zealand's Call to the Botanist, an illustrated lecture by Charles Chilton.

Friday, August 6.

The Tapestry Forests of the Island of Oahu. Vaughan MacCaughey.

Saturday, August 14.

Owing to the death of Charles N. Forbes, Mrs. Forest Brown was appointed secretary.

Some Problems in Plant Physiology and Ecology in Hawaii. H. F. Bergman.

The Field Label in Botany. Elmer D. Merrill.

Monday, August 16.

Joint meeting of the Section of Botany with the Section of Biology. For program see "Section of Biology."

Wednesday, August 18.

The Flora and Phytogeography of Japan and Adjoining Regions. K. Shibata.

Notes on the Algae of the Northwest Coast. T. C. Frye.

The Medicinal Plants of the Philippines. Leon M. Guerrero.

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#### SECTION OF ENTOMOLOGY.

Wednesday, August 4.

Section organized with F. Muir, Leader, and D. T. Fullaway, Secretary.

Assignment of topics to members of the Section.

Tuesday, August 17.

Some Problems in Hawaiian Entomology. F. Muir.

Need of Further Exploration and Study of the Hawaiian Insect Fauna and Value of Such Study in the Exploration of the Pacific. O. H. Swezey.

Some Aspects of Economic Entomology in Hawaii. D. T. Fullaway.

What Horticultural Inspection Has Done and Can Do for Hawaii. E. M. Ehrhorn.

Ideas on How an Entomological Expedition Should be Conducted. F. X. Williams.

Medical Entomology. D. L. Crawford.

Discussion on the necessity for further entomological exploration in the Pacific area.

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#### SECTION OF GEOGRAPHY.

Monday, August 2.

Section organized with William Bowie, Leader, and G. W. Littlehales, Secretary. The work of the Section was outlined.

Tuesday, August 3.

Observations of Temperature and Salinity at Selected Coastal Stations in Japan; accompanied by an index-chart showing the location and extent of regularly observed hydrographical sections on the coast of Japan. K. Kishinouye.

The Desirability of Supplying Information in Greater Detail Upon Sea Charts. N. Yamasaki.

The Extent to which the Contours of Configuration of the Basin of the Pacific Ocean have been Made Known by Deep-sea Soundings; including an account of methods of deep-sea soundings, and of the mathematical investigations which have been made to define the theoretical form of isolated submarine peaks, and the intervals which should obtain between deep-sea soundings to disclose the topography of the bottom of the ocean. G. W. Littlehales.

The Investigations in Physical Oceanography of the Scripps Institution of the University of California. George F. McEwen.

Thursday, August 5.

The Growth and Present Extent of Ocean Magnetic Surveys, with an account of the investigations in Terrestrial Magnetism by American Institutions. J. T. Watkins.

The Purposes, Instruments and Methods of the Hawaiian Magnetic Observatory, with Its Records and Publications. Harold McComb.

On the Atmospheric Electricity of the Hawaiian Islands. Lawrence H. Daingerfield.

Friday, August 6.

Meteorological Centers of Action in the North Pacific Ocean. E. A. Beals.

Researches in the Geodetic Work of the Pacific. William Bowie.

Saturday, August 14.

Extent of Geographical Surveys in the Hawaiian Islands. George R. Davis.

Monday, August 16.

Low-Sun Phenomena in Luzon. Willard J. Fisher.

Tropical Geology and Engineering. Warren D. Smith.

Tuesday, August 17.

Consideration of resolutions to be presented to the general sessions of the Conference.

Wednesday, August 18.

Consideration of resolutions to be presented to the general sessions of the Conference.

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#### SECTION OF GEOLOGY.

Monday, August 2.

T. Wayland Vaughan was selected Leader of the Section. The Chairman outlined the work before the Section and a tentative program was arranged.

Tuesday, August 3.

Harold S. Palmer was appointed Secretary of the Section. Presentation of formal papers was postponed until the arrival of the delegates from the south and west.

Thursday, August 5.

The Structural Framework of the Pacific. E. C. Andrews.

The Melanesian Plateau, with Especial Reference to the Land Shell Fauna. Charles Hedley.

Salient Features of the Geologic Structure of the Philippine and Neighboring Islands. Warren D. Smith.

The Essential Structural Features of Japan. N. Yamasaki.

The Relation of Gravimetric Surveys to the Framework of the Pacific Region. William Bowie.

The Structure of the Cordilleras of North and South America. Rollin T. Chamberlin.

The Structure of the Caribbean Region. T. Wayland Vaughan.

Letters from Professor Bailey Willis of Stanford University and Dr. Alfred H. Brooks of the U. S. Geological Survey were read.

Friday, August 6.

The Basis of the Correlation of the Tertiary and Quaternary Geologic Formations of the Pacific Islands. T. Wayland Vaughan.

Correlation of the Tertiary of Australia and Adjoining Regions. C. A. Sussmilch.

Correlation of the Geologic Formations of Australia. E. C. Andrews.

The Stratigraphy of the Philippine Islands. Warren D. Smith.

The Fossil and Existing Foraminifera of the Atlantic and Pacific Regions. Joseph A. Cushman.

The distribution of the molluscan fauna was discussed by H. A. Pilsbry, and that of the Foraminifera by T. W. Vaughan.

Saturday, August 14.

Geodetic Research in the Pacific Region. William Bowie: listened to jointly by the Sections of Geology and Geography.

The Status of Areal Geologic Mapping in the Pacific Region was discussed by T. Wayland Vaughan for the Americas; by J. Allan Thomson for New Zealand; by E. C. Andrews for New South Wales and the outer islands; by H. C. Richards for the rest of Australia; and by N. Yamasaki for Japan, Korea and China.

It was proposed to summarize the progress in the Pacific region by a series of key maps. The work was divided as follows:

New Zealand.....	J. Allan Thomson
Australia.....	E. C. Andrews
The Philippines.....	W. D. Smith
Japan, Korea and China.....	N. Yamasaki
North and South America and Dutch East Indies.....	T. Wayland Vaughan
Antartica.....	L. A. Cotton

Monday, August 16.

Indurated Glacial Clays from Australia. C. A. Sussmilch.

The Status of Areal Geologic Mapping in the Philippines. Warren D. Smith.

A letter from Dr. Alfred H. Brooks pointing out the need of work on the correlation of Alaskan areal stratigraphy with that of eastern Siberia and northwestern Canada was read.

Consideration of resolutions to be presented to the general sessions of the Conference.

Tuesday, August 17.

The Glaciation of the Mountains in Japan. N. Yamasaki.

Discussion of Glaciation by T. Wayland Vaughan, Rollin T. Chamberlin, C. A. Sussmilch, E. C. Andrews, T. A. Jaggar, Jr., Alfred G. Mayor, Paul Bartsch and W. Alanson Bryan.

The Great Barrier Reef and the Reefs of Fiji. E. C. Andrews.

Coral Reefs on Tutuila. Rollin T. Chamberlin.

The Ecology of the Reef Corals of Tutuila. Alfred G. Mayor.

Chemical Investigations Relating to Corals. Roger C. Wells.

Theories of the Formation of Coral Reefs. T. Wayland Vaughan.

Wednesday, August 18.

Possible Deformation Resulting from Slight Wanderings of the Pole. L. A. Cotton.

Consideration of resolutions for presentation to the general sessions of the Conference.

Thursday, August 19.

Joint meeting with the Section of Volcanology and Seismology.

Earthquake Frequency with Special Reference to Tidal Stresses in the Lithosphere. L. A. Cotton.

Pit Craters and the Persistence of Vents, Henry S. Washington.

The Chairman of the Section of Geology made the following assignments:

Country	Geologic Mapping	Stratigraphic Correlation
New Zealand	J. Allan Thomson	J. Allan Thomson
Australia	E. C. Andrews	H. C. Richards
China, Korea, Japan	N. Yamasaki	N. Yamasaki
North and South America	T. W. Vaughan	T. W. Vaughan
Dutch East Indies	T. W. Vaughan	T. W. Vaughan
Philippine Islands	Warren D. Smith	Warren D. Smith

The work of the Committee on Sedimentation of the Division of Geology and Geography of the United States National Research Council. T. Wayland Vaughan.

## SECTION OF SEISMOLOGY AND VOLCANOLOGY

Monday, August 2.

Section organized with F. Omori, Leader, and T. A. Jaggar, Jr., Secretary. The work of the section was outlined.

The Growth of the Work of the Hawaiian Volcano Research Association. L. A. Thurston.

The Organization of the International Research Council. H. S. Washington.

Tuesday, August 3.

Pulsatory Oscillations. F. Omori.

The Present Status of the Seismological Work in the Pacific, a paper sent to the Conference by Otto Klotz, of the Dominion Observatory, Ottawa, Canada, and read by the Secretary.

Extract from a letter by Harry Fielding Reid of Johns Hopkins University, dealing with seismology in the Pacific.

Thursday, August 5.

Volcano Types and the Chemistry of Magma. H. S. Washington.

Friday, August 6.

Hawaiian Earthquakes. T. A. Jaggar, Jr.

Tectonic Controls in the Case of Volcanic Earthquakes. H. O. Wood.

Volcanic Tremors and Volcanic Earthquakes. F. Omori.

Monday, August 9.

Volcano House, Hawaii.

The Volcanoes of the Pacific. H. S. Washington.

Tuesday, August 10.

Volcano House, Hawaii.

A Program of Experimental Volcanology. T. A. Jaggar, Jr. Earthquake Zones in and Around the Pacific. F. Omori. Regional Seismology vs. World Seismology. H. O. Wood.

Saturday, August 14.

Joint meeting with the Section of Geography. For program see report of the Section of Geography.

Sunday, August 15.

Discussion of the resolutions to be presented to the general Conference.

Monday, August 16.

Report of the Section of Volcanology of the American Geophysical Union. H. S. Washington.

Tuesday, August 17.

Discussion and Drafting of Resolutions.

Wednesday, August 18.

Joint meeting with the section of Geology; for program see report of that Section.

Thursday, August 19.

Joint meeting with the Section of Geology; for program see report of that Section.

The joint meeting was followed by a session of the Section of Seismology and Volcanology in which the following papers were presented.

Seismical Phenomena at Samoa. G. Angenheister; read by Arnold Romberg.

Historical Statement of the Growth of Seismology in the Philippines. M. S. Maso.

Friday, August 20.

Exhibition of records made with a special duplex pendulum, and maps of soundings in Kagoshima Bay before and after eruption of Sakurajima. F. Omori.

Notes on Seismic Triangulation with Instruments of more than one Magnification for Regional Seismometry. H. O. Wood.

## DELEGATES PAN-PACIFIC SCIENTIFIC CONGRESS

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AGEE, H. P.,  
Agriculturist, Director Experiment Station Staff, Hawaiian Sugar  
Planters' Association, Honolulu.

AITKEN, R. T., B. S.,  
Anthropologist, Public Museum, Milwaukee.

ANDREWS, E. C., B. A.,  
Geologist, Chief Geological Survey, New South Wales.

BAKER, ALBERT S., M. A., B. D., M. D.,

BARBER, EDWARD,  
Naturalist.

BARTSCH, PAUL, B. S., M. S., Ph.D.,  
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National Museum.

BEALS, E. A.,  
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BERGMAN, H. F., Ph.D.,  
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BOWIE, WILLIAM, B. S., C. E., M. A., Sc.D.,  
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BRIGHAM, W. T., A. M., Sc.D.,  
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BROWN, FOREST B. H., M. S., Ph. D.,  
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BRYAN, WILLIAM ALANSON, B. S.,  
Zoologist.

BRYAN, EDWIN H., Jr., B. S.,  
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CHILTON, CHARLES, F. L. S., M. A., Sc.D., M. B., C. M.,  
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CRAWFORD, DAVID L., M. A.,  
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CUSHMAN, JOSEPH A., B. S., Ph.D.,  
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DAINGERFIELD, LAWRENCE H., Ph.D.,  
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DAVIS, GEORGE R.,  
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DEAN, ARTHUR L., Ph.D.  
    President, University of Hawaii, Honolulu.

DILL, H. R.,  
    Professor of Biology, University of Iowa.

DILLINGHAM, FRANK T., A. M.,  
    Professor of Chemistry, University of Hawaii.

DONAGHHO, JOHN S., A. M.,  
    Professor of Astronomy and Mathematics, University of Hawaii.

EDMONDSON, C. H., Ph.D.,  
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EHRHORN, E. M.,  
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EMERSON, JOSEPH S., B. S.,  
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EMORY, KENNETH, B. S.,  
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EVERMANN, BARTON W., B. S., Ph.D.,  
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FISHER, W. J., Ph. D.,  
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GROSVENOR, GILBERT, A. M.,  
    President National Geographic Society, Editor-in-Chief National  
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GUERRERO, LEON M., Phar. D.,  
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## I. GENERAL RESOLUTIONS.

### I. FUTURE CONFERENCES.

Since the present Conference has been found highly inspiring and illuminating and an invaluable aid in defining the essential problems of the Pacific Region, be it

RESOLVED, That future similar conferences should be held at intervals of not over three years.

### 2. PERMANENT ORGANIZATION.

The results of the First Pan-Pacific Conference have demonstrated the high value of meetings for the discussion of problems common to all countries whose interests lie wholly or in part within the Pacific area; and have shown that the problems relating to the welfare of Pacific peoples are too large and too complex to be solved satisfactorily except by sympathetic cooperation of individual institutions and governmental agencies. To develop a unity of interest and to make harmonious coordination practicable, it seems desirable that some permanent organization be established which may serve as the point of contact for representatives of various interests in the countries of the Pacific. Be it therefore

RESOLVED, That the attention of the Governor of Hawaii be called to the great opportunity afforded by an organization designed for the advancement of the common interests of the Pacific, including scientific research, and to the desirability of taking action which may lead to the development of such an organization vouched for and supported by the various Pacific countries.

### 3. INTERNATIONAL RESEARCH COUNCIL.

Since this Conference commends the organization of the International Research Council as a means toward coordinating research in science, be it

RESOLVED, That it is the desire of this Conference that any agency created for the guidance of scientific research and exploration in the Pacific region may be affiliated with the Council and with the various National Research Councils of the nations of the Pacific.

#### 4. SHIPS FOR EXPLORATION.

The cost of scientific researches in the Pacific which involve the continuous use of a ship is prohibitive for most scientific institutions and individuals. The results of the Challenger and the Wilkes expeditions have demonstrated the great advantage gained by the use of government-owned ships for scientific exploration. Be it therefore

RESOLVED, That the members of this Conference unite in inviting the attention of governments to the desirability of providing vessels for suitably planned expeditions.

#### 5. PROMOTION OF EDUCATION.

The results of scientific research have led to extensions of human knowledge and to increased control of the forces and resources of nature the values of which cannot be measured. All scientific work which is well done is of value, and no man can predict to what useful purposes the results of any investigation, no matter how recondite, may be put. It is of fundamental importance that sufficient numbers of young men and women of first class ability shall be adequately trained, and that teachers and investigators shall be properly compensated. This Conference therefore

##### RECOMMENDS:

(a) That in order that young men may enter upon scientific careers without sacrificing all hope of reasonable financial returns, the compensation for instruction and for research in science be increased so that all can at least be assured of a comfortable living for themselves and their families, and that men of exceptional attainments may receive financial rewards which shall approximate those which their powers could command if directed to commercial ends.

(b) That persistent efforts be made to inform the public of the progress of science and of its bearings upon the practical affairs of life.

(c) That to enlarge the experience and vision of the instructors in the colleges and universities of the Pacific countries, making them thereby more competent and inspiring teachers, the exchange of teachers between institutions in different countries be encouraged and made possible.

(d) That a clearing house of information relative to oppor-

tunities for scientific study and research in the Pacific area be established.

(e) That arrangements be perfected between the universities and other research institutions whereby properly qualified students may move from institution to institution carrying on their work at the place or places where the best facilities are available for the special kind of work upon which each may be engaged.

(f) That a considerable number of fellowships, with adequate stipends, be provided, which shall be looked upon as compensation for the faithful performance of scientific work, and that especially able work by young investigators be rewarded by substantial prizes.

(g) That to stimulate interest in the Pacific and inculcate a knowledge of its importance and unity, text books be prepared in which proper emphasis will be placed upon the Pacific area, its physical features, peoples, fauna, flora, resources, and trade, and that the schools in Pacific countries be encouraged to give instruction which will stimulate the interest and enthusiasm of young students in the objects and phenomena of their environment.

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## II. ANTHROPOLOGY.

### 1. NEED FOR POLYNESIAN RESEARCH.

Recognizing the necessity for the immediate prosecution of anthropological research in Polynesia, this Conference calls the attention of governments, patrons of research, and research foundations to this important scientific need, and

RECOMMENDS, That the most prompt and efficient steps be taken to record the data necessary to the understanding of man's development in the Pacific area.

### 2. FACILITIES FOR INSTRUCTION AND RESEARCH IN ANTHROPOLOGY.

Since there is urgent need both for anthropological research and the training of men and women therefor, and since experience has shown the advantage of close association between the graduate departments of universities and persons and institutions carrying on anthropological investigations, this Conference

RECOMMENDS, That centers be created for the study of anthropology and original research therein, such centers to be developed by the expansion of university departments or the alliance of universities with other research institutions with the result that these schools of anthropology shall combine all the essential features of a museum, a research staff, and a graduate school. And, further, because of the peculiar conditions under which anthropological data must be gathered, necessitating both intensive field work in circumscribed areas extending over several years, and intensive synthetic work by men who are masters in many fields, thus requiring a number of men through a period of years, we therefore recommend the establishment of research fellowships in Polynesian anthropology, such endowments being provided that these fellowships will attract the best men available and provide for uninterrupted work during an adequate number of years.

### 3. THE BAYARD DOMINICK EXPEDITION.

It is evident that fuller knowledge of the history and culture of the Polynesian race is essential to the solution of the ethnologic problems of the Pacific; and also that the opportunities for obtaining information are rapidly disappearing. It is therefore gratifying to learn that Mr. Bayard Dominick has conceived a plan for ethnological studies in the Pacific on a scale not hitherto attempted and has provided funds for the initiation of this research under the guidance of Yale University and the Bishop Museum.

RESOLVED, That the commendation of this Conference be extended to Mr. Dominick for his far-sighted interest and generosity and that assurance of good will and cooperation be given him.

### SHIPS FOR BAYARD DOMINICK EXPEDITION.

The Bayard Dominick expedition of the Bishop Museum is now in the field and the successful continuation of its work depends upon obtaining a ship suitable for the navigation of waters outside of established trade routes.

The Conference invites attention of the United States Government to the benefits likely to result from providing this expedition with a suitable vessel.

## III. BIOLOGICAL SCIENCE.

## I. MARINE BIOLOGICAL SURVEY.

The necessity for conservation of natural resources has become imperative, since, in the case of the Pacific Ocean, certain economic marine species have been exterminated and others are in peril of extinction or grave depletion. Measures for such conservation must be based on an exact knowledge of the life histories of marine organisms. Knowledge of the biological, physical, and chemical phenomena of the Pacific Ocean is meager and wholly inadequate to serve as the basis for rational conservation measures; therefore be it

## RESOLVED:

(a) That the First Pan-Pacific Scientific Conference recommends that the governments of the several nations bordering on the Pacific Ocean cooperate, through their several agencies concerned in surveying and charting the sea, toward the collection, compilation and publication of data relating to the topography of the bottom, and the temperature, salinity, acidity, currents, and other physical and chemical properties of the waters of this ocean, fundamental to biological research and the improvement and conservation of the fisheries.

(b) That the Conference recommends that a comprehensive systematic biological survey of the Pacific ocean and its contained islands be undertaken, with special reference to the economic fisheries problems and that the investigation be carried on in so far as possible through existing agencies, such agencies to be provided with the additional apparatus and facilities necessary, the investigation to be carried on under such cooperation as will prevent duplication of effort.

(c) That the Conference recommends that the several museums, biological stations, and other institutions engaged in biological investigations relating to the Pacific ocean, associate themselves for the purpose of exchanging information concerning past, current, and proposed investigations, the exchange of facilities and personnel, the coordination of work, and the prevention of duplication in their respective activities. It is further recommended that a survey be made of the facilities afforded by the several institutions, said survey to cover material, equipment, environment, and the personal qualifications of the respective staffs

for supplying special information and working up material. It is further recommended that the National Research Council of Washington, D. C., be invited to undertake or arrange for such survey and that a committee of this Conference be appointed to represent the interests of the botanical and zoological sections in this regard, the committee to be appointed by the Chairman of this Conference.

(d) That the Conference recommends that systematic statistics of the fisheries be collected and published annually and that such statistics be, as far as possible, uniform in character and in such detail as to methods of fishing and geographical distribution as to make them useful in fisheries administration and conservation. It is further recommended that the several governments provide for a joint commission for the arrangement of the details of such statistical compilations.

## 2. RECOMMENDED INVESTIGATIONS IN MARINE BIOLOGY.

Because of the urgency or importance of certain investigations, this Conference

### RECOMMENDS:

(a) The collection of bottom samples from depths under 20 fathoms, since these are not usually obtained by deep sea expeditions and can be readily obtained at anchorage by simple apparatus.

(b) The study of the brachiopod faunas above the 1000 fathom line inasmuch as a knowledge of these Brachiopods supplies important evidence on the question of former land connections.

(c) A systematic and thorough study of Pacific Ocean algae and of the conditions under which they occur and of the part they play in their environment; this could be obtained by means already employed for certain parts of the Pacific Ocean and would be of great scientific value.

(d) Because the Hawaiian Islands lie on the margin of the tropical seas, and therefore occupy a critical position for the study of the ecology of marine organisms, among which corals are important; and because data obtained from ecologic investigations in this locality would be of value to geologists in interpreting the conditions under which fossil faunas lived, the Conference recommends a careful study of the ecology of the marine organisms

of the Hawaiian Islands, and particularly a study of the corals and of the organisms associated with the corals on the reefs.

### 3. LAND FAUNA.

The part played by living animals in the solution of many scientific problems in the Pacific is well recognized. The relationship of their present to their former areas of distribution and to that of extinct allied forms is the key to some of the geological problems; they have direct bearing upon many ethnological problems and they are the chief source of evidence upon which our ideas of evolution must be built. From a knowledge of the land fauna follow great economic advantages, such as the protection of the human race against many diseases and crops against pests.

Although in certain continental Pacific areas and some of the larger islands the land fauna is fairly well known, yet in none is knowledge yet complete, and in some, such as Polynesia, it is very deficient. The urgency for this work is great, as large areas are rapidly being swept of their native land fauna. Therefore this Conference

#### RECOMMENDS:

(a) That surveys, as complete as possible, be made of the land fauna, especially of those smaller islands in which the native fauna is fast disappearing, or is likely to become extinct in the near future.

(b) That the attention of zoologists be called to recently made land areas due to volcanic or other activity and the importance of the study of ecological development with special reference to the appearance of animal life upon such areas.

(c) That since land mollusks supply information of value in zoogeographical researches, material for a comparative study of the anatomy of the soft parts of land snails be obtained from all the high islands of Polynesia, Micronesia, and Melanesia, and that adequate faunistic collections be made on islands the faunas of which are not at all or only partially known.

### 4. ORNITHOLOGICAL SURVEY OF THE PACIFIC

This Conference expresses its gratification at the fact that arrangements have been made by the American Museum of Natural History for the purpose of undertaking and carrying on a comprehensive and intensive ornithological survey of the islands

of the Pacific Ocean, particularly those of the South Seas, and extends its thanks to those who have made provision for the expedition.

### 5. COLLECTING POLYNESIAN LAND FLORA.

Since a definite knowledge of the flora of Polynesia is essential to a proper understanding and correlation of numerous problems bearing on the life and origin of Polynesian peoples, problems of forestry, agriculture, ethnobotany, plant diseases, physiology, and ecology; since the original vegetation of some island groups is rapidly being destroyed; and since botanical exploration of Polynesia has been sporadic and in many regions incomplete, therefore the First Pan-Pacific Scientific Conference

#### RECOMMENDS:

(a) That botanical exploration of Polynesia be extended as rapidly as possible in order to assemble comprehensive collections with as complete notes as possible covering the scientific and economic aspects of Polynesian botany.

(b) That this work of exploration be carried on by existing agencies, by special botanical expeditions, and by heads of non-botanical expeditions employing and supervising native collectors, whenever feasible, for the collection and preservation of botanical material.

(c) That material be collected in bulk, from ten to fifteen specimens of each species, with the object of distributing duplicate specimens to Pacific institutions and to the larger botanical centers of the world.

### 6. PLANT ECOLOGY ON LAVA FLOWS.

Since new lava flows and other volcanic ejecta offer fresh terrane for the abode of life, therefore this Conference

RECOMMENDS, That studies be made of the stages of ecological development with special reference to the appearance of forms of plant life on new volcanic deposits following an eruption; and also of plants best suited to the speedy rehabilitation for agricultural uses of regions covered by such volcanic ejecta; and of the resistance of plants to volcanic fumes.

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## 7. PRESERVATION OF THE HILLEBRAND GARDEN (HONOLULU)

Since the botanical garden of the late Dr. William Hillebrand, author of the "Flora of the Hawaiian Islands," situated in the city of Honolulu, is one of the most remarkable gardens in the world, possessing as it does many unique and rare plants introduced into the Hawaiian Islands by Dr. Hillebrand, and since this Conference believes that the preservation and perpetuation of this garden, which is threatened with destruction, would be a great benefit to botanical science, it recommends that the steps be taken to insure the preservation of this garden.

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## IV. GEOGRAPHY.

### 1. TOPOGRAPHIC MAPS.

The exploration of Pacific regions in many branches of science is handicapped by the almost total lack of topographic maps. There is scarcely any human activity which does not depend to a greater or less degree upon a knowledge of the configuration of the land. This is especially true in such work as mining, railroad and highway extension, and maintenance, and the utilization of water in power development, irrigation, and transportation. The natural resources of the world cannot be discovered and utilized efficiently without such maps.

Topographic maps of any given area should be adapted in scales, accuracy and details, to the scientific and economic needs peculiar to the area.

The benefits derived from adequate topographic maps are far greater than their cost and this Conference urges that a plan be made for carrying on a topographic survey of the lands of the Pacific regions, and that this plan be designed to give uniformity of results. This Conference commends the countries of the Pacific region for the work already done by them.

### 2. SURVEY OF THE SHORELINE AND COASTAL WATERS.

A general hydrographic survey of the continental shelves extending off-shore to the one-thousand fathom curve and of

the island platforms should be executed, in order to supply basic data essential to all research work involved in the general scientific exploration of the Pacific ocean.

This survey should establish a system of horizontal and vertical control, determine the shore line and adjacent topographic features in true geographic position, develop submarine relief, collect and describe the materials of the bottom, observe temperature and salinity, and define vertical and horizontal movements of the water. The hydrographic bureaus of the nations of the Pacific, as now organized and operating, need only to expand their equipment and extend their field to meet the requirements of this project. Closer cooperation is desirable in the interest of uniformity and to avoid duplication.

These results, in addition to their bearing upon research work, have so great economic value to the shipping, fisheries, and other marine interests that the cost of the survey for the collection of the necessary data is relatively insignificant. It is stated in a recent publication of the United States Coast and Geodetic Survey that the vessels wrecked in the coastal waters of California, Oregon, and Washington in the year 1917 on account of the incompleteness of the charts, involved a loss which amounted to more than double the estimated cost of a complete hydrographic survey of those waters.

This unfinished state of the hydrographic survey along the west coast of the United States is not exceptional; few regions of the Pacific of any considerable extent have been thoroughly surveyed. This Conference makes appreciative acknowledgment of the notable contributions made to the survey of the coastal waters of the Pacific by the several nations bordering thereon; but in view of the magnitude of the work and the length of time involved in its execution it commends this general project and urges its early execution.

### 3. USE OF WIRELESS TELEGRAPHY IN LONGITUDE DETERMINATION.

This Conference commends the use of wireless telegraphy for the improvement of determination of the longitude of the islands in the Pacific.

### 4. MAGNETIC SURVEY.

The general magnetic survey of the Pacific ocean should be

continued to an early conclusion and provision made for such additional work as may be needed to determine annual and secular changes in the magnetic elements. The field of work should be extended to include the coastal waters, where the magnetic phenomena are complex, and their determination essential to many important interests.

Systematic operations under this project are a comparatively recent undertaking; but already excellent results have been obtained in the Pacific from the work of the Carnegie Institution of Washington.

The work is of immediate and vital importance to navigation and surveying, in addition to its bearing upon the general subject of geophysics, and this Conference hopes that plans may be made for a complete magnetic survey of the Pacific region and that the work may be expedited.

## 5. PHYSICAL OCEANOGRAPHY.

Oceanographic investigations yield results which constitute a basis essential for scientific exploration and research in the Pacific region, notably in meteorology, geology, botany, and biology. Moreover, such investigations are of importance to navigators in disclosing dangers to vessels sailing the ocean and are of economic value in enabling vessels to save time and fuel in their navigation.

The present knowledge of the oceanography of the Pacific is deficient in every branch and constitutes but a meager array of data scattered widely.

In the oceanographic investigation of the Pacific waters the configuration of the bottom should be determined, specimens of the bottom deposits collected and their thickness and stratification revealed, the physical and chemical characteristics of the water at different depths and times determined, and the horizontal and vertical circulation of the waters observed.

The field work involved in such investigations must be carried on almost entirely by the governmental hydrographic organizations of the countries bordering on and contained within the Pacific ocean, owing to the great expense involved in creating new and special agencies, and because the governmental agencies have the personnel trained in this work. Those carrying on oceanographic surveys in the Pacific should avail themselves of the services and advice of individuals and

organizations dealing with those branches of science depending upon the results of such surveys.

This Conference feels that a systematic oceanographic investigation of the Pacific should be undertaken as soon as possible. The plan adopted should be designed to complete the survey of the most critical areas at an early date, and eventually of the whole Pacific region.

## 6. METEOROLOGY.

Investigations in meteorology or the physics of the atmosphere designed to lead to an accurate scientific knowledge of atmospheric phenomena are of recognized importance. Very little is known of the behavior of the upper air over the land, and still less over the ocean. The fundamental aspects of these phenomena are exhibited in their simplest manner over the greatest of oceans, the Pacific. Hence it is necessary to make meteorological observations over the Pacific for use in studying the more complex problems over the land.

Moreover, the collection and prompt dissemination of marine meteorological data are of great benefit to humanity in carrying on its commerce and in weather forecasting which is now limited by a lack of synchronized, uniform meteorological data over great areas not within the customary track of vessels.

Observations at the place of origin of typhoons, hurricanes, larger cyclonic and anticyclonic areas, as well as the development, dissipation, oscillation, and translation of the same, are essential to successful forecasting and the study of ocean meteorology. Moreover, the meteorological survey of these ocean areas has practical value. Therefore, the governments of the countries bordering on the Pacific ocean are invited to consider carefully these matters with a view to increasing the number of meteorological vessel and land stations within the confines of this ocean and on its borders, especially the establishment of vessel reporting stations in somewhat fixed positions. In considering these matters, it is believed that special attention should be given to increasing the number of stations in the well known "centers of action."

The First Pan-Pacific Scientific Conference commends the ocean navigation companies and their masters of vessels for the valuable assistance they have rendered the meteorological services

of several stations and urges them further to cooperate especially in the matter of transmitting their weather reports by radiograph as well as by mail.

#### 7. METEOROLOGICAL STATION ON MACQUARIE ISLAND.

Since the observations made at the meteorological station on Macquarie Island resulted in improvements in the accuracy of weather forecasting, this Conference expresses the hope that observations at that station, interrupted by the war, may be resumed at an early date.

#### 8. METEOROLOGICAL STATION ON MAUNA LOA.

In view of the fact that Mauna Loa, Island of Hawaii, the highest accessible point in the central Pacific, offers exceptional opportunities for the exploration of the upper air, this Conference recommends that a station of the first order be established on its summit for continuous meteorological observations.

#### 9. EARTH TIDES.

The successful operation of the Michelson earth-tide apparatus at a station in the United States of America has furnished data from which the knowledge of the physical characteristics of the interior earth has been increased, and it is desirable that earth tide stations be established in the Pacific region at widely separated points in order to discover whether the physical characteristics vary from place to place.

This Conference hopes this work will be extended.

#### 10. ISOSTATIC INVESTIGATIONS.

Investigations in the theory of isostasy have thrown much light on the subject of deviation from the normal densities in the outer portions of the earth, which is of importance in the study of geology and in other branches of science.

Much can be added to our knowledge of isostasy by a mathematical reduction of existing field data, following well known methods, which would involve only slight expense.

This Conference urges, in the interest of geophysical and other sciences, the early reduction of existing geodetic data

and the extension of geodetic field work to those regions of the Pacific where such data are now lacking.

This Conference commends the Coast and Geodetic Survey of the United States, the Trigonometric Survey of India, and the Dominion Observatory of Canada for work they have done in isostatic investigations.

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## V. GEOLOGY.

### 1. GEOLOGICAL MAPS.

Since it is in the interest of science and of value in the development of the natural resources of the different countries concerned, be it

RESOLVED, That the following maps of the Pacific region on the international scale of 1:1,000,000 be completed as expeditiously as possible:

- (a) A base map showing by contours or hachures as many topographic features as practicable.
- (b) A map showing geological formations or groups of geological formations.
- (c) A map showing mineral resources.

### 2. GEOLOGICAL SURVEYS OF CRITICAL INSULAR AREAS IN THE PACIFIC OCEAN.

#### GEOLOGICAL SURVEY OF EASTER ISLAND.

Since a knowledge of the geology of Easter Island might throw light on the question of whether there was in past geological time a westward extension of the land area of the South American continent, be it

RESOLVED, That it is desirable to have a careful study of Easter Island to determine the character and geologic age of the rocks composing that island.

#### GEOLOGICAL SURVEY OF THE HAWAIIAN ISLANDS.

Since the results of a detailed geological survey of the Hawaiian Islands would aid in the solution of many problems of the Pacific region, be it

RESOLVED, That this Conference strongly recommends

that a geological survey of the Hawaiian Islands be made and that appropriate geological maps and descriptive texts be published.

GEOLOGICAL SURVEY OF SEVERAL SMALL ISLANDS IN EASTERN FIJI.

Since raised coral atolls with exposed basements of bedded limestone or of volcanic material are found in eastern Fiji, and since a geological survey of these islands supplemented by reconnaissance work in the neighborhood of Suva would be invaluable in the study of the origin of coral reefs, and in the elucidation of the geology of the southwest Pacific, be it

RESOLVED, That a topographic and geological survey of the several small islands, such as Mango, Thithia, Lakemba, Vanua Mbalavu, and Tuvutha be made at the earliest opportunity, and the results published.

3. FORM OF OCEAN BOTTOM.

Because of their importance as supplements to geological work on land in determining the structural framework of the Pacific region and in interpreting the geological history of the region, be it

RESOLVED:

(a) That the configuration of the bottom of the Pacific ocean be determined with adequate accuracy.

(b) That charts of the littoral and sub-littoral zones be made in all practicable detail; for example, wherever possible these charts should be on scales ranging between 1:10,000 and 1:40,000.

4. POST-CRETACEOUS CORRELATION.

Since such knowledge is essential to the establishment of an adequate basis for the stratigraphic correlation of the post-Cretaceous formations of the Pacific region, be it

RESOLVED:

(a) That in addition to the study of the post-Cretaceous stratigraphy and paleontology of the Pacific islands and of the land areas on the margins of the Pacific ocean, such work

also be expedited in the Caribbean region and in the region from Burma through the Himalayas to the Mediterranean sea.

(b) That inventories of the living fauna and flora of the Pacific region be prepared at the earliest practicable date.

## 5. STUDIES OF SUBAERIAL AND SUBMARINE EROSION.

Since it is coming to be recognized generally that a knowledge of subaerial and submarine erosion is indispensable to a correct interpretation of the history of the continents, the continental margins, and the oceanic islands during post-Cretaceous time, be it

### RESOLVED:

(a) That geologists, geographers, seismologists, biologists, and others who are interested in the facts of form within the Pacific ocean and along its margins devote attention to the study of physiographic processes and the forms resultant from such processes.

(b) That geologists and physiographers make special study of the physical, chemical, and other properties of igneous and sedimentary rocks so as to ascertain the difference in their resistance to erosive agents.

(c) That efforts be made to obtain assistance in furthering the study of wave and current erosion, the factors limiting wave base, the action of weathering and corrosive agents at the headwaters of streams, the forms of stream channels, the form of sea cliffs at different stages of development, the action of plants in retarding land erosion, and the sequential stages of erosion of fault scarps.

## 6. STUDIES OF SEDIMENTARY PROCESSES AND SEDIMENTARY ROCKS.

Since it is generally recognized that the interpretation of a large part of the geological record demands a knowledge of the processes of sedimentation and the results of these processes in the formation of deposits of past geological time, therefore be it

### RESOLVED:

(a) That geologists, oceanographers, geographers, biolo-

gists, and others who may be interested devote as much attention as possible to the study of modern sediments and the processes by which they are formed.

(b) That geologists make special studies of the physical, chemical, and other properties of sedimentary rocks to ascertain the conditions under which the deposits were formed and the changes that may have taken place in such sedimentary rocks after deposition.

(c) That all existing agencies be urged to study the phenomena referred to in paragraphs (a) and (b) above, and that efforts be made to increase the number of agencies for the prosecution of such investigations.

#### 6. GEOLOGICAL COOPERATION.

Since it is desirable that the projects undertaken by the different workers in the Pacific region be so selected and so designed that each may be supplementary to the rest and so contribute to the uniform accumulation of geological information concerning the Pacific region, be it

RESOLVED, That steps be taken to advise in the planning of research, to correlate the efforts of the different workers, and to promote in such ways as may be proper a uniform mode of publication of results.

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#### VI. SEISMOLOGY AND VOLCANOLOGY.

The dominant motive which has appeared in the convention of seismologists and volcanologists of the Pacific here gathered together for the first time, has been to promote more localized and more continuous observation of regional phenomena than has hitherto been accomplished in most seismic and volcanic districts. On the other hand, there is agreement that precise teleseismic triangulation is not a field for amateurs or for stations equipped with a multiplicity of inferior and diverse instruments.

There is urgent need for mutual information, regularly supplied by each observer to his distant colleagues, concerning volcanic and seismic happenings in each land. The employment of mariners and scientific expeditions to collect specimens and notes for the volcanologists in remote places may be organized.

Education of the people in matters of earthquake-proof con-

struction and safeguards against disaster has been proved to be a practicable and effective method of meeting volcanic and seismic crises.

Interest has recently developed in the earth tide, changes of level about volcanoes, and measurable horizontal and vertical displacements directly related to earthquakes. These are matters for the national geodetic surveys and for geophysical investigation of high mathematical precision.

The consideration of the needs indicated above, namely, localized work, distribution of information among workers in this field, education of the people at large, and the applications of precise geophysics has led to the following resolutions:

#### 1. ESTABLISHMENT OF VOLCANO OBSERVATORIES.

Useful volcano experiment stations have already been established in some lands, and more volcanologic experience is needed for protection against disaster of the increasing populations of Pacific countries and for the advance of science; therefore this Conference

RECOMMENDS the continuance of the present volcano observatories and the establishment of new permanent volcano observatories in lands about the Pacific; and recommends that such a station for maintenance and publication of continuous observations should be placed on one or more active volcanoes in each important volcanic district.

#### 2. PROMOTION OF LOCALIZED SEISMOMETRY.

In addition to the work of existing establishments, the intensive study of both large and small earthquakes in seismic provinces by all appropriate physical, geological and other scientific methods may lead to important and rapid advancement in geophysical knowledge. This knowledge is of importance for economic and humanitarian as well as scientific ends. This Conference therefore

COMMENDS the existing institutions, recommends their continuance and expansion, and urges early establishment of further specific programs of investigation and continuous observation in regional seismology in special seismic districts about the Pacific. Timely publication of results is recommended. Moreover this conference recommends to the National Research Council of the United States the establishment of a pro-

gram of research in regional seismology in the southwestern part of the United States.

### 3. PUBLICATION OF VOLCANO AND EARTHQUAKE INFORMATION.

The workers in regional seismology and volcanology need accurate information about geophysical events in other localities than their own; therefore this Conference

RECOMMENDS, That prompt and authoritative publication of current facts and measurements concerning volcanoes, earthquakes, submarine eruptions, and tidal waves be an essential part of the routine of all Pacific observatories.

### 4. PRECISE LEVELING AND TRIANGULATION IN RELATION TO VOLCANOLOGY AND SEISMOLOGY.

Great earthquakes and volcanic eruptions are often preceded and followed by elevations, depressions, and horizontal displacements in the regions concerned; therefore this Conference

RECOMMENDS, That precise leveling and triangulation be carried on at definite time intervals, in selected seismic and volcanic districts, in order to ascertain precursory and other changes in underground stress accompanying great seismic and volcanic disturbances.

### 5. COLLECTION AND PUBLICATION OF STATISTICS OF EARTHQUAKES AND ERUPTIONS.

There is needed for certain Pacific countries more complete statistics concerning earthquakes and eruptions; and a complete list for the world should eventually be maintained; therefore this Conference

RECOMMENDS, That each Pacific country publish statistical lists of local eruptions, earthquakes, tidal waves, and other related phenomena; and issue catalogues of active, dormant and extinct volcanoes, and of local seismic features.

### 6. CENTRAL SCIENTIFIC BUREAU.

Dissemination of volcanologic and seismologic knowledge will be furthered by working through a body cooperating with all Pacific countries; therefore this Conference

RECOMMENDS the establishment of a central bureau for dissemination of scientific knowledge among the volcano and earthquake stations of the Pacific.

### 7. SAMOAN GEOPHYSICAL STATION.

This Conference COMMENDS highly the work done at the Geophysical Observatory at Apia, Samoa, and expresses the hope that the service of that station will be continued.

### 8. EDUCATION OF DWELLERS IN DISTRICTS LIABLE TO DISASTER.

Great injury and loss of life to persons and damage to human constructions may be caused by earthquakes and volcanic eruptions and may be decreased by general education; therefore this Conference

RECOMMENDS, That countries liable to seismic disaster educate the people in proper methods of construction, in behavior during emergencies, and in the history of such catastrophes elsewhere.



